STAFF WORKSHOP

BEFORE THE

CALIFORNIA ENERGY RESOURCES CONSERVATION

AND DEVELOPMENT COMMISSION

In the Matter of:)
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2005 BUILDING ENERGY EFFICIENCY)
STANDARDS)
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CALIFORNIA ENERGY COMMISSION

1516 NINTH STREET

HEARING ROOM A

SACRAMENTO, CALIFORNIA

TUESDAY, AUGUST 27, 2002

10:07 A.M.

Reported by:
Peter Petty
Contract No. 150-01-005

STAFF PRESENT

William Pennington

Bryan Alcorn

Maziar Shirakh

Elaine Hebert

ALSO PRESENT

Charles Eley
Eley Associates

Douglas Mahone
Jon McHugh
Heschong Mahone Group

Hashem Akbari
Lawrence Berkeley National Laboratory

Steve Brennan
Davis Energy Group

Thomas Trimberger
California Building Officials

Gary Fernstrom
Pacific Gas and Electric Company

Patrick Eilert
Marshall Hunt
Pacific Gas and Electric Company

Tony Pierce
Southern California Edison Company

Gregg Ander
Southern California Edison Company

A.Y. Ahmed
Occidental Analytical Group
Consultant to Southern California Gas Company

Randall Higa
Southern California Gas Company

ALSO PRESENT

Dave Springer
Davis Energy Group

Dave Ware
Owens Corning
representing NAIMA

Robert E. Raymer
California Building Industry Association

John Hogan
City of Seattle

Steven D. Gates
James J. Hirsch & Associates

I N D E X

P R O C E E D I N G S

10:07 a.m.

MR. ALCORN: I'd like to welcome everyone to today's workshop -- over there talking with Pat Eilert, who's the Project Manager, and responsible for the technical development of this contract.

Also Charles Eley to my right is the prime contractor to the Energy Commission for this round of the building standards.

I would also like to acknowledge the Commissioners' offices. I saw Commissioner Rosenfeld here earlier, although I don't see him now. He may be listening in from his office upstairs, as well as Commissioner Pernell, and their Advisors, John Wilson and Rosella Shapiro.

The purpose of this workshop today is to discuss the fourth group of measure analysis reports. There will be five reports presented, and they will be discussed in the order that they appear on the agenda.

The format for today's workshop will be the same as previous workshops; that is the first 15 minutes for each presentation will be a brief overview of the proposal, itself. And the remaining 30 minutes will be for questions and comments. So each topic will receive 45 minutes in time.

You've all heard this before but I just want to remind everyone about a couple of housekeeping items. There is a sign-in sheet outside; hopefully you have all stapled your business cards to that sign-in sheet.

Also if you could provide a copy of your business card to the court reporter, who's over here adjusting my microphone. His name is Peter. He will probably wave at you if he can't hear you. If he can't hear you it's because you're not speaking directly into the microphone.

I'd like to point out that the taller microphone is the microphone for the Commission's PA system. And that's the microphone that is broadcasting over the internet. And the smaller microphone is the recorder's microphone. So if you're not speaking into both of these mikes, you're not being heard on the internet and you're also not being recorded by the transcriber. It means that your comments will not be included in the transcription. So, please, be aware of that.

Also, during the lunch hour if we could

all move out of the hearing room. The reason why is because there have been some private conversations recorded over the internet. We don't like to turn the microphones off. So at the lunch hour, if we could move out of the hearing room and have private conversations outside in the lobby, that would be great.

The first presenter today is Charles Eley. Charles will be presenting the first two topics, electronically commutated motors and size threshold for variable speed drives.

So, with that I'll be quiet and let Charles make his presentation.

MR. ELEY: We'll start the first slides of ECM motors. The research for -- the ECM motors proposal was suggested back in November by John Hogan at the City of Seattle.

The research on this topic was done by Newport Design Consultants with assistance from Eric Kolderup in our office, and Mark Hydeman at Taylor Engineering.

Next slide, please. Basically the series fan powered box is used in variable volume systems to maintain a relatively constant air flow at the zone level.

Often in like a conference room or something like this there's no heat load. And the primary air volume is reduced to a point where the air circulation rate would be quite small to satisfy the load.

So for occupant comfort and to overcome the perception of stuffiness there's a fan located in a series power terminal unit; an illustration is shown here. And this fan runs pretty much continuously during the operating hours of a building.

And furthermore, these fans are pretty inefficient and there's a good opportunity here to save energy.

Next slide, please. The series fan powered boxes are available in different physical sizes. They range from about 400 cubic feet per minute up to about 2000 cubic feet per minute. And they have fan motors that range from about a quarter horsepower up to 1 horsepower.

As I mentioned, fan motors are typically very inefficient; 40 to 50 percent. And when they operate at part load they're really inefficient, 15 to 20 percent. They have a very primitive type of speed control.

Some larger, if you have a larger space then fan powered boxes can be configurated with multiple motors and multiple fans.

Next slide, please. Basically an ECM motor is a direct current motor as opposed to an alternating current motor. They're quite efficient compared to the kinds of fans or types of motors that they would replace.

They're greater than 70 percent efficient. And much of this efficiency is due to an efficient speed control. We would add a new definition for an electronically commutated motor, and the text of that is provided here, and also in the research report. I won't bother to read it here, but it's pretty straightforward.

Next slide. So we would add a requirement or modify section 144(c)(2) and it would read: Fan motors of 1 horsepower or less in series terminal units shall be electronically commutated motors, or shall have a minimum motor efficiency of 70 percent when rated in accordance with NEMA standard MG1 in full loaded rating conditions. So this is the language that would go into the standards.

Next slide, please. This shows the

relative fan power for both AC motors and ECM motors. This is -- you might have better success if you turn to the report on this; it's on page 11 of the report.

(Pause.)

MR. ELEY: This curve at the top -- the x axis of this is air flow in cfm and it ranges from zero up to 2500 cfm. And the vertical axis, or the y axis, is fan power.

This curve at the top is a one horsepower AC motor. The curve directly below it, the solid line, is a one horsepower ECM motor. So, if you compare this curve to this curve you can see the power savings for different fan volumes, for air flow volumes.

The other curves show different sized motors. This is for a three-quarter horsepower motor and so forth.

Next slide, please. This presents the data in a little bit different way. This shows for air flow what the difference is between those curves that we just saw.

So we're looking at power savings in the range of 110 to 390 watts. And there's a significant variation in the savings. In some cases one size of induction motor might be selected to provide the same air flow as a single ECM.

For example, savings are low when air flow is at the high end of the one horsepower production motor range. And savings increase to a point where a three-quarter or one horsepower induction motor is required.

So, these data show the savings from two manufacturers, Titus and Nailor.

Next slide, please. And this figure here shows the present value of savings. There's four air flow ranges here, 500, 1000, 1500 and 2000 cfm. So the savings in watts, there's a high and a low range there. And then these are the savings in terms of kilowatt hours. So this is peak and this is kilowatt hours.

And then using our life cycle cost data, this shows the present value of those energy savings. So they're at a low of about $639 for the low flow up to about $1000. From about $900 to $2200 for the larger motors providing 2000 cfm of flow.

Next slide. The cost premium for an ECM motor is on the order of $155 to $250 per motor.

If you add a 30 percent markup to that for general contractors and HVAC contractors overhead and profit, that brings it up to about $200 to $325. And this cost premium is significantly lower than the present value of the energy savings that were shown on the previous slide.

If you go back to the previous slide, the lowest -- back up, yeah -- the lowest number was about $639. So, it's still very very cost effective.

And that's it, Bryan, thanks.

MR. ALCORN: Okay, terrific. Do we have any questions or comments on Charles' proposal? Tom Trimberger.

MR. TRIMBERGER: Tom Trimberger representing California Building Officials. Good morning.

I didn't -- the cost that you showed, the measure cost doesn't account for anything to provide DC power to the building. That typically isn't there, whereas it seems like they would have some cost to provide DC power to the building.

MR. ELEY: You don't really need to provide DC power to the building. The motor has its own rectifier that takes the AC power and converts it to DC, which is used. So that's all part of the electronics.

MR. TRIMBERGER: Okay, so it wires --

MR. ELEY: Right, --

MR. TRIMBERGER: -- up --

MR. ELEY: -- you wire it up to standard line voltage.

MR. TRIMBERGER: Wonderful. The only other issue I had, I think, in the proposed standards language, there could be some confusion fan motors of one horsepower or less in series terminal units. Do we define series terminal units?

MR. ELEY: Not very well, I guess. That's a very good comment; and we should probably add a definition.

MR. TRIMBERGER: And terminal units is already used to be like a wall AC type of thing, too. So somehow, you know, I don't know if you want to say specifically variable air volume, because there are constant volume boxes. But I think that needs to be made clearer to avoid some confusion.

MR. ELEY: That's an excellent comment. We need to make that change.

MR. TRIMBERGER: And I had one other thing. Not coming to me. Oh, for the savings did you look at -- there you've got the low and the high values, basically as to whether the unit is running on low speed or high speed.

Did you try to apply that to a typical what the box would be running over at the -- throughout the year?

MR. ELEY: Yeah. The kilowatt hour savings were based on simulations, so they accounted for the -- the peak watt savings were based on manufacturers' reported data. The variation was just variation between manufacturers.

MR. TRIMBERGER: Oh, that's the low-highs, the variation of the manufacturers?

MR. ELEY: Yeah, right.

MR. TRIMBERGER: Okay. Thank you.

MR. ELEY: Right. But the energy numbers are based on annual operating hours.

MR. TRIMBERGER: Okay, thank you.

MR. ALCORN: Gary Fernstrom.

MR. FERNSTROM: Gary Fernstrom, PG&E. PG&E supports this measure as the California utility new construction and retrofit programs have long supported variable frequency drives and have found them to be cost effective in air handlers.

I do have one question, however. I presume the efficiencies you're showing and the savings you're showing are for the fan motor system, where you're looking at the power for equivalent air flow with variable speed versus conventional AC motors; as opposed to just the electrical efficiency of the motor by itself?

MR. ELEY: That's correct.

MR. FERNSTROM: Thank you.

MR. ALCORN: Tom Trimberger.

MR. TRIMBERGER: I don't want to steal the mike here. Just one other question. Looking back at the original 28 or so measures that we were going to proceed, we talked about VAV fan controls and staged volume fan controls.

Are those names changed to electronically commutated motors in series terminal units? Is that the same thing, or is that something different?

MR. ELEY: No, they're different. ECM motors is sort of a less than one horsepower version of a variable speed technology. And so this particular recommended code change would only apply for the small motors that are used for fan powered boxes.

Next we'll be talking about the requirement for variable speed drives in the next topic that's coming up, and the two-stage -- I'm not sure the status of that one; that was one that was --

MR. TRIMBERGER: Then we had VAV fan controls somewhere.

MR. PENNINGTON: Southern California Edison is working on a compliance option for the -- what's the latest name of this, Tony?

MR. PIERCE: Stage volume 8.

MR. PENNINGTON: Okay, stage volume. So that --

MR. TRIMBERGER: So we haven't heard that workshop yet, okay.

MR. ELEY: So there's really three proposals. You're about to hear the second one.

MR. TRIMBERGER: All right, thank you. I'm just trying to keep track of everything.

MR. ELEY: And the third one would be a compliance option.

MR. ALCORN: Okay, great. Marshall

Hunt.

MR. HUNT: Marshall Hunt, PG&E. On the life cycle savings calculation I'm assuming that's not TDV; it's just the straight --

MR. ELEY: No, this is straight. This is just using the $1.37 per kilowatt hour saved.

MR. HUNT: So it would be more beneficial with --

MR. ELEY: It would be -- it would look even more favorable were you to use the -- TDV because these motors operate during peak.

MR. HUNT: Thank you.

MR. ELEY: In fact, they operate -- their power's higher during peak.

MR. ALCORN: Ahmed.

MR. AHMED: Two quick questions, Charles. Just a little understanding, what percent of new construction uses this sort of technology, terminal units?

And second, what is the base price of the standard motor? Because you gave us the incremental motor costs, and I was just wondering how does it compare with the base price.

MR. ELEY: You know, those are both good questions, and I'm not sure I've got the answer to either one of them.

SPEAKER: Mr. Hogan.

MR. ELEY: John may have.

MR. HOGAN: John Hogan, City of Seattle. We've had this requirement in effect in our Seattle energy code, and have found the implementation going very smoothly with this.

Responding to some of the specific questions, we're finding the more efficient type of VAV system has the parallel fans. And so you're not running -- the series fan you're running the motors all the time, running the fans all the time.

What we're finding is that more and more people are shifting to series because there's this perception of improved indoor air quality by the tenants if there's air moving. Doesn't mean the air is better, but they feel it moving, so they feel it's better. So more and more people are shifting this way.

So I can't give you the percentages, but when we had this discussion during our coded option, the presumption was that all the designers, all the contractors saying, yeah, we're putting in these systems. So it's certainly a majority of cases.

MR. ELEY: I would say that there's several of these series fan powered boxes in every building that has got VAV. You typically find them in conference rooms and interior spaces where the thermal loads from the envelope are small. And it's pretty common.

So, they're pretty widespread, but I don't have the figures.

MR. PENNINGTON: So, John, do you have any idea what the cost is for this? That was Ahmed's other question there. The base cost?

MR. HOGAN: Right. No, just the increment; I'm not aware of the base cost.

MR. ELEY: The units are -- the motor, itself, is not priced separately, though. I mean we could go to the Titus or Nailor catalogue and get the price for the whole fan powered box. But it comes with the motor and, you know, everything as a single unit.

MR. AHMED: Right, just a question of curiosity because we have the incremental cost, we don't have a the base cost to get an idea.

MR. ELEY: I'm guessing they range from -- my hunch is they -- Tony, you may have some figures, but I'm guessing like $2000 up to -- $1500 up to maybe $3000, something like that, for the total cost of the fan powered unit.

MR. AHMED: Right, and then when you switch the motor it's $300 more basically?

MR. ELEY: Right.

MR. AHMED: Okay.

MR. ALCORN: Bob Raymer, did you have a question? Okay. Are there any more questions on this presentation?

Okay. Seeing and hearing none let's move to the second presentation which Charles is also presenting.

MR. ELEY: This research was done by the same group of people, Eric Kolderup in our office, Mark Hydeman from Taylor Engineering, and Lanny Ross with Newport Design Consultants.

Next slide, please. We've had a requirement in the standard for some time that any VAV fan system that has more than 25 horsepower, the motors have to either have a variable speed drive, or they have to be an axial vane fan with variable pitch. Or they have to use some other technology so that they use less than 30 percent power, of maximum power at 50 percent air flow.

This requirement has been in, I believe, since '92. There's been a parallel requirement in ASHRAE 90.1.

Next slide, please. In the last ten years or so the cost of variable speed drives has dropped considerably. They've become more reliable. Power quality problems have been solved. And they're becoming more and more a part of the mainstream of building construction, sort of like electronic ballasts are in the lighting area.

So this proposed change is to reduce the size threshold from 25 horsepower to 10 horsepower. So with this change any fan motor in a variable speed system larger than 10 horsepower would be required to have a variable speed drive.

And it's key to the motor size, in this case, not the brake horsepower of the fan.

Next slide, please. This shows the costs for different types of fan control. So we have motor sizes ranging from one horsepower, two, three, five, seven and a half, 10, 15, 20 up to 25 horsepower.

And there's four options shown here: Constant volume, which means no control of the fan volume; discharge dampers, which means that there's discharge dampers that open and close at the outlet from the fan and volume is controlled that way; essentially increased pressure across the fan.

Inlet vanes, which is a technology that's used pretty common for centrifugal fans. There's these spiral vanes at the inlet to the drum that directs the air and is able to vary the volume. And then finally variable speed drives.

So this shows the cost for these types of technologies. You can see that variable speed drives start at about $2700 and increase up to about close to $7000 for a 25 horsepower motor.

These data are all from the means cost guide. The cost for inlet vanes includes both the damper plus the actuator motor.

And the cost for the variable speed drive includes the NEMA 1 enclosure which is required; and the same is true for the constant volume fan.

Next slide, please. The horizontal axis or the x axis is motor size. And this shows savings for a low rise building. On the vertical axis is the present value of the energy savings for that motor operating in the situation of the low rise residential building.

So these curves all emanating from zero are different climate zones. You can see that in some climate zones like climate zones 5 and 6, very mild conditions, the benefits of the variable speed drive are smallest.

In some climate zones like the magenta here is climate zone 2; the savings are pretty high there, and so forth.

The solid line that cuts across here shows the present value of the incremental cost for the variable speed drive in comparison to the inlet vanes, which is, in our opinion, most common basecase.

So this shows that at 10 horsepower the variable speed drive is cost effective, even in climate zone 5, the climate where the benefits are least.

And in some climates it's actually cost effective to put in the VSD at 5 horsepower or even 4 horsepower or less.

Next slide, please. There's actually a typo here; this should say high rise office. But this shows the same data this time for a high rise office building. These savings are all calculated using DOE2 simulations and using the schedules of operation that are specified in the nonresidential ACM. Here the size threshold is a little bit lower, at about 8 horsepower.

So anyway, based on this analysis the recommendation is to require VSDs for motors 10 horsepower and greater. And that covers everything. And as you can see from these data there's a number of instances when it's cost effective to do it even in smaller motor sizes, but that's not being recommended.

We want to keep this simple. We're not going to specify different size thresholds for different climates or anything like that.

That's it, Bryan.

MR. ALCORN: Okay, thank you, Charles. Lights back on, please. Okay, do we have any questions or comments? I see Doug Mahone here first.

MR. MAHONE: Yeah. Charles, I just had a question, a measure like this, I think, depends a fair amount on how well it's controlled. Is there any obvious problems that these might not be well enough controlled to be cost effective, or the controls would, in a worst case, lead to greater energy consumption?

MR. ELEY: You mean -- by control you mean the position of the pressure sensor in the duct system, or --

MR. MAHONE: Well, assuming that that's, I mean, I imagine there's a variety of ways that these can be controlled through a central energy management system or through a local pressure sensor or some --

MR. ELEY: Right.

MR. MAHONE: -- control and --

MR. ELEY: Well, typically the way they're controlled is there's a pressure sensor position somewhere in the duct system, and the speed of the motor is varied to maintain a given, a set pressure at that position.

And that's the case with inlet vanes or variable speed drive or anything. So whatever control problems that you're going to have, I don't think, would be made any worse or better by going with variable speed drive.

There are a lot of issues, though. I don't want to diminish the issues, but there's definitely some issues around where you locate that pressure sensor and how it's handled in the energy management system.

MR. ALCORN: I think Bill Pennington wants to respond.

MR. PENNINGTON: One thing I would add, if you look on page 16 in the performance verification section there is an anticipation that it's important to make sure these things get installed right. And there's a proposal that we develop acceptance requirements for this measure.

MR. ALCORN: Jon McHugh.

MR. McHUGH: Jon McHugh, HMG. Charles, my recollection of these DOE2 curves is that they're assuming that the pressure in the duct is decreasing with decreasing speed. And as part of this proposal are you proposing that there be a pressure reset control similar to what the ASHRAE 90.1 has for VAV systems?

MR. ELEY: No, that's not part of the proposal.

MR. McHUGH: Okay. I would just make the recommendation that the Commission consider looking into that, since essentially the main benefit from adjustable speed drives is that you're actually reducing your static pressure.

MR. PENNINGTON: Would it be possible, Jon, for you to identify the section in 90.1 that you're talking about?

MR. McHUGH: Certainly; I could send you a citation.

MR. PENNINGTON: Thanks.

MR. ALCORN: Thanks, Jon. Ahmed, question?

MR. AHMED: Charles, a couple questions. This analysis that was done, again, was it done under TDV or was it the straight analysis?

MR. ELEY: This is a straight analysis using the $1.37 per kilowatt hour saved.

MR. AHMED: The second question, is this 10 horsepower requirement for all fans? Because there are package systems that have 10 horsepower fans and their constant volume with no variations in volume.

MR. ELEY: Not for all fans, but for all variables. For all VAV fans.

MR. AHMED: Right, all VAV fans then.

MR. ELEY: Right, 10 horsepower and greater. Right. I believe all the manufacturers have an option for VSD on equipment at that size.

MR. AHMED: Right, but it's not a

requirement to have VSD right now in the standards. All you got to meet is the efficiency requirements, not the VAV requirements for package systems.

MR. ELEY: For constant volume?

MR. AHMED: Right.

MR. ELEY: Yeah, that's still the same.

MR. AHMED: That still remain the same. So if they choose VAV then they have to meet this requirement?

MR. ELEY: If it's a VAV system then the 10 horsepower kicks in. Then they have to put in VSD.

MR. AHMED: Okay, I just wanted to get it clear.

MR. ALCORN: Tom Trimberger.

MR. TRIMBERGER: In the useful life in the opening portion they say that one of the side effects of VSDs is that it corrupts the power. Do you put any extra hidden cost for filters or anything? Is that included in your analysis?

MR. ELEY: We did not put in any cost for the possibility that there were power quality problems. I believe most of those, I mean the manufacturers tell us that those problems have been corrected.

You know, ten years ago there were some definite power quality problems associated with this, but the manufacturers are reporting that this is not an issue anymore.

MR. TRIMBERGER: One more question. You know, we're looking at providing this requirement down to smaller motors. Typically I look at large package VAV units are going to be the larger motors. Do you know what percentage of them are going to be between the 10 and 25 percent of the market, or --

MR. ELEY: I think this requirement's essentially going to affect all variable speed systems, or all variable air volume systems. I don't think there's going to be too many VAV systems that are going to be less than 10 horsepower.

So, it could be, but, you know, a variable air volume system is, by definition, a multizone system. So you're dealing with more than one thermal zone, otherwise you wouldn't do it. And I think they're all going to be 10 horsepower or greater.

MR. TRIMBERGER: Yeah, because I'm

saying typically they're -- it's pretty easy to meet even 25, but they don't get down below 10 very much.

MR. ELEY: So, in essence, this is going to require VSDs from all VAVs.

MR. TRIMBERGER: Thank you.

MR. ALCORN: Thank you. Do we have any more questions or comments on this presentation?

MR. AHMED: Just one clarification. I just wanted to make a clarification that there are systems, Charles, like Carrier's VVT system. Sometimes some office buildings, even though they may have a 10 horsepower fan in a package system, they might call it a variable volume system, although it is really not a true variable volume.

MR. ELEY: That's really a constant --

MR. AHMED: So will it be exempted?

MR. ELEY: -- volume system that you're describing.

MR. AHMED: Right, right.

MR. ELEY: And this requirement would not apply to that.

MR. AHMED: Will not be applying, okay.

MR. ELEY: The fan operates at a constant volume in that case.

MR. TRIMBERGER: That might be something that would be useful to mention in the manual, not standards.

MR. ELEY: Right, I agree.

MR. ALCORN: John Hogan.

MR. HOGAN: I wanted to respond to Jon McHugh's issue, the language in standard 90.1 is in section 63322 and 63323. And this is for whether or not there's a static pressure sensors. And there's two requirements.

One, 63322 has the static pressure sensor location, which is no greater than one-third the total design static pressure. And 63323 has a set point reset, and says if you have DDC systems then you need to reset it based on the zone requiring the most pressure.

So we've adopted both those requirements into our code in Seattle. And we would encourage you to do that. And I think there certainly are advantages. If you could require DDC you could get great benefits from this. We didn't feel we could require DDC. But more and more people are doing it, so if they are doing it, it's easy to take advantage of this; it's a valuable thing to do.

I'd also like to point out that the Seattle and Washington State energy codes apply these VSD requirements to pumps, also. So wherever the threshold is set it applies to pumps, as well as fans. And I would encourage the Commission to consider that, also.

Thank you.

MR. ALCORN: Thank you, John. Are there any more questions or comments on this presentation?

Okay, seeing none and hearing none, we'll move to the next presentation. It's limitation on the use of lay-in insulation, and Jon McHugh will be presenting.

MR. McHUGH: Good morning. I'm going to be talking about the limitation on the use of lay-in insulation in nonresidential buildings.

Just to clarify for anyone who's not clear what a lay-in insulation is, that's insulation that's laid directly on top of acoustic ceiling tiles and T-bar ceilings. On the slide here you see a picture of a T-bar ceiling with acoustic ceiling tile.

Next slide, please. So, this is actually part of PIER research, Public Interest

Energy Research funded by the California Energy Commission. And one of the hypotheses was that laying insulation on top of an acoustic tile ceiling is not thermally equivalent to insulating the roof deck of commercial buildings.

And this proposal would require that we insulate roof decks and the side walls of plenums directly below the roof deck instead of laying insulation on top of a T-bar ceiling whenever the plenum height, that distance between the ceiling and the roof, is less than 12 feet.

Next slide, please. Just what we're talking about in terms of ceiling locations. One place that we can insulate currently that we're allowed to insulate ceilings is we can actually insulate T-bar ceilings directly on top of the ceiling.

Next, please. We can insulate directly underneath the roof deck. Next, please. Or we can insulate directly on top of the roof deck.

And typically when we insulate on top of the roof deck we're looking at using rigid insulation; whereas the other two locations we're typically using fiberglass batt insulation.

Next slide, please. And in the

discussion of the 12-foot plenum height, this is what I mean by plenum height, that distance between the ceiling and the roof deck.

Next slide, please. And so we're essentially looking at the tradeoffs of -- this picture here shows the conditioned space at the bottom, below the dark line. And we have two ways we can insulate that space. One is that we insulate the entire volume of the building, so we insulate the side walls; we insulate the plenum side walls; and we insulate the roof deck. Or we just insulate the ceiling and the side walls of the conditioned space.

The standards would currently require that we use the same level of insulation at the ceiling level as we would at the roof deck. And as you'll see, there's some tradeoffs between doing that, because essentially the insulation placed at the ceiling level tends to have more defects; tends to have more infiltration. And so it's not as effective as insulation placed at the ceiling.

Next slide, please.

SPEAKER: At the roof and roof deck.

MR. McHUGH: I'm sorry, at the roof

deck. So, as part of the PIER research we visited 13 buildings that were identified as having lay-in insulation. We wanted to know, just over time, does that lay-in insulation actually stay in place.

Anecdotally, from doing prior energy audits, when I've poked my head up into the ceiling plenum I've seen insulation tossed on the side because people access the ceiling plane to work on either HVAC equipment or move around light fixtures, and so the insulation gets tossed around.

But what we didn't have was a data set of insulation coverage that had been methodically collected over a sample of buildings. And what we found was that we found voids in insulation from a high of 95 percent, so basically 95 percent of the insulation missing, to a low of only 7 percent of the insulation missing. So, of that ceiling plane, in some cases only 7 percent of that ceiling area was uncovered.

MR. RAYMER: What was the usual --

MR. McHUGH: The usual was somewhere between 10 and 40 percent. And so that was of uncovered. And you look at that low of 7 percent, essentially, you know, 7 to 10 percent is the ceiling area that typically has troughers in there, and those troughers typically are not IC rated, so right off the bat essentially there's 10 percent that's uncovered.

And so if you have 7 percent coverage, that means pretty much all the tile areas are covered.

MR. WARE: John.

MR. McHUGH: Yes.

MR. WARE: I was just trying again to clarify. When you said voids, 95 to 7 percent difference, you're -- it's not voids in the installation of the insulation, per se, but rather voids in the ceiling system where insulation, such as troughers, where insulation is not placed over them?

MR. McHUGH: Well, it's both, because with the 7 percent, yes, if someone has consciously chosen not to insulate the troughers, as they shouldn't, because of the heat buildup --

MR. WARE: Correct.

MR. McHUGH: -- but the remainder of the voids are essentially missing insulation. Either the insulation's been tossed over, or it wasn't installed in the first place.

MR. WARE: And 7 to 95 percent is just a subjective estimate of what was there?

MR. McHUGH: No, no. This was part of this research; we actually had people count out the ceiling tiles where insulation was missing. So we actually had, you know, it was quantitative, not qualitative. So we're looking at areas.

Next slide, please. And from these 46 observations there's the scatter of the data. And you can see that most of the data is, you know, between 10 and 50 percent. We had these two sort of outlier buildings where there were just a few shreds of insulation left in the buildings, old building.

And what's actually kind of interesting about this is that we were expecting to find that there would be this progression of less and less insulation coverage over time. And what we found is that actually quite a bit of these buildings, even new buildings, had a similar spread, you know. That they were still clustered in that 10 to 40 percent of the area uncovered. So it's, I think, somewhat interesting.

Next slide, please. We took this

information and we put it into a frequency histogram so that we could then make use of this data in terms of how we simulate a T-bar ceiling. Saying essentially that there's probabilities of insulation voids when lay-in insulation is used on acoustic tile ceilings. And so this is what we used as the basis.

And to the extent we were a little bit conservative in that we took those two situations where there was essentially hardly any insulation left in the ceiling plenum and we just lumped those with the other ones that were around 50 percent uncovered.

Next slide, please. The next thing we did was we also looked at air infiltration across the ceiling plane. And the Florida Solar Energy Center has taken extensive pressure and flow measurements for different building types, and have published test data on the effective leakage area of T-bar ceilings.

They're an order of magnitude higher than the leakage areas that you find through drywall ceilings. Shouldn't be that surprising. And we used the leakage areas in the ASHRAE handbook of fundamentals for the other building component leakage areas. And we basically did a pressure network analysis to evaluate the air infiltration through T-bar ceilings.

Next slide, please. We used the same DOE2.2 model that was also used in the analysis of duct ceiling, duct insulation and used a prototypical single story office space of 2000 square feet. And we looked at a couple different conditions.

One was a mass wall with troughers, in which case some fraction of the heat from the troughers went up into the plenum. Mass wall with pendant lighting; frame wall with pendant lighting; and we also looked at T-bar ceilings versus drywall ceilings.

Next slide, please. To perform the cost effectiveness analysis we used the cost numbers that are on the slide.

Next slide, please. And we also used these cost numbers. Now what's interesting when you look at all this, is that on this last bullet that insulation under the roof deck, and not insulating the plenum wall, because it turns out that for mass buildings if you use a U-factor method, you don't necessarily have to insulate the side walls of the plenum, because it's a high mass wall. And so there's lower U factors -- I'm sorry, higher U factors that are maximums for the U factor method.

When you just insulate underneath the roof deck and you don't pay extra to tighten up your ducts, that cost is equal to or cheaper than putting lay-in insulation and tightening your ducts. And you'll see why this is important as we go forward.

Next slide, please. Now, one of the other things in there, two slides earlier, shows that insulation -- above-deck insulation is substantially more expensive than under-deck insulation. And but for our cost effectiveness evaluation we only look at the below-deck insulation.

When people choose to use above-deck insulation they're doing it for other reasons, such as if they want to use the plenum as a return plenum; they want to have a flat substrate over metal decks; or they want to have, you know, there's static reasons why people put insulation above decks.

And looking at this we thought it was

desirable to have, for enforceability to have a single insulation position requirement for the entire state, rather than having a climate zone by climate zone requirement that you go across the street and have a different requirement.

And we also thought it desirable to have some flexibility to allow lay-in insulation for the small conditioned offices that you find in a warehouse or a manufacturing facility. So, we didn't want to be Draconian, we just wanted to capture the majority of the energy savings.

Next slide, please. So one of the first things we looked at is the cost effectiveness if duct sealing, because this impacts -- there's a tradeoff between duct sealing and ceiling insulation.

And what we find is that when you have insulated the deck, the roof deck and the side walls, that the cost effectiveness is low for sealing the ducts because most of the heat loss ends up in the space.

Whereas when we have insulation at the roof deck -- or, I'm sorry -- when we have insulation at the ceiling level and we don't insulate the roof deck, then, as we can see here, we have, you know, cost effectiveness of 3 and above, or benefit/cost ratios of 3 and above. So it's very cost effective to seal and insulate ducts.

Next slide, please. This next slide shows the total TDV dollar consumption of a building; so this is a present valued life cycle cost of energy consumption over 30 years with 3 percent discount rate that's the basis of TDV. And that's what we see on our Y axis.

And on our X axis the results vary with the height of the plenum. And this is in climate zone 3; and this building has masonry walls.

And the first set of bars that we're looking at is a situation where we have lay-in insulation and it has tight ducts. As we saw earlier, if we have lay-in insulation, tightening the ducts is very cost effective.

So, next, please. So we compared that with an insulated drywall ceiling. Substantially lower energy consumption, especially at low plenum heights due to the ceiling has less infiltration. And because we're in climate zone 3 which is very mild, you actually have this sort of non intuitive effects happening where being coupled to the thermal mass and the side walls actually has some benefit as plenum heights increase.

Next. The next bar is where we have insulation under the roof deck; and we've also insulated the side walls of the plenum. And in this situation the duct isn't tight because it's just not that cost effective to do that.

And finally, last -- next one, please. Here we actually have the side walls insulated at the roof, but the side walls are uninsulated. Again, there's some benefit from coupling to the thermal mass in this mild climate.

So it's kind of interesting, you know, in terms of that in some cases more insulation increases your energy consumption.

Next slide.

MR. WARE: Jon, when you ran that analysis, and I think from the report -- anyway, my question is are you assuming a ventilated roof in those last two scenarios, insulation is at the roof deck?

MR. McHUGH: No.

MR. WARE: Okay, I didn't think you were.

MR. McHUGH: That's right, you get a

dramatically different answer.

MR. WARE: Yes.

MR. TRIMBERGER: Jon, the plenum height you defined as --

MR. McHUGH: Right.

MR. TRIMBERGER: We're not talking about a return air plenum that is being used as --

MR. McHUGH: No, this is all ducted returns.

MR. TRIMBERGER: Okay, so I'm just -- the word plenum kept throwing me off.

MR. McHUGH: Yeah.

MR. TRIMBERGER: So it's really the attic height is the plenum height, as you defined it, but it's really not a plenum.

MR. McHUGH: Right.

MR. PENNINGTON: We're going to have to be careful with the definition of that dimension. I agree.

SPEAKER: I'm not sure you'd want to call it an attic, either.

MR. TRIMBERGER: Yeah, attic doesn't quite do it, either.

MR. McHUGH: Yeah, we can work on the definition.

MR. TRIMBERGER: But the standards language is pretty -- you don't call it plenum in the standards.

MR. McHUGH: Okay.

SPEAKER: Right.

MR. McHUGH: Okay, this is the same analysis, but here we're looking at climate zone 12; and just the opposite of climate zone 3. When you look at the last two situations where you've insulated the roof deck, now if you don't insulate the side walls your energy consumption increases. Now you're coupled to a pretty hot outdoor climate and it has a negative impact on your TDV consumption.

The main thing to note here is that both a drywall ceiling and insulating the roof deck and insulating the side walls is fairly -- or TDV dollar equivalent. And that in most situations there's, you know, a good amount of savings from going from lay-in insulation to one of these other methods of insulation.

And that the benefit of doing this is dramatically reduced as the plenum height increases.

Next slide, please. So finally what we

looked at is the benefit/cost ratios. And what we see here is that for climate zone 3 it's cost effective to require under-deck insulation when -- this is when the side walls are insulated up to six feet.

When we look at under-deck, insulating underneath the roof deck, but the side walls are uninsulated, well, the benefit/cost ratio is infinite because the incremental cost is zero and yet there's still energy savings.

And then finally when we look at a drywall ceiling which had a similar TDV savings, it has a benefit/cost ratio less than 1 just because a drywall ceiling is substantially more expensive than a T-bar ceiling.

Climate zone 12, we have similar things except that insulating in locations other than T-bar ceilings is cost effective for a greater range of plenum heights.

Next slide, please. So here we're doing the same kind of analysis where we looked at the benefit of duct sealing. In this case the wall type that we're looking at is a frame wall. And again what we see is that it's very cost effective above an insulated ceiling; and it's not so cost effective under an insulated roof deck.

Next slide, please. Similar type slides. Again, you see that what's interesting is the frame wall now is less sensitive to plenum height; and we've removed the bar where the side walls were uninsulated. Because with a frame wall you have to insulate the side walls when you put insulation at the roof deck.

And so what we see is that for frame walls there's less of an effect of plenum height.

Next slide, please. Same thing for climate zone 12. Next slide, please. And when we look at the benefit/cost ratio we find that for all plenum heights it's very cost effective to insulate the roof deck and insulate the side walls. And it's not cost effective for climate zone 3 to require drywall ceiling, but it is in climate zone 12.

Next slide. So just to summarize that, when it's roof insulation cost effective we found that in mild climates, in climate zone 3 and 6, that for mass buildings when the plenum heights were less than 9 feet tall, it was cost effective.

For frame buildings all plenum heights,

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roof insulation was cost effective. And in our warmer climates all wall types up to 12 foot plenum heights insulating the roof was cost effective.

Next slide. So, you know, we found that an insulated drywall ceiling, in general, was not cost effective. It was cost effective only in extreme climate zones. And the reason being is that it costs significantly more than standard insulated T-bar ceilings.

However, it had similar TDV cost savings. Even though it has a higher life cycle cost we think that designers should have the option of using drywall. It's not cost effective because of its first cost, not because of its energy savings.

And so -- but the final bullet is is that the prohibition of using insulated T-bar on these lower plenum heights is based on a comparison to insulated roof decks, because that's the basis of the requirement to disallow lay-in insulation. But nonetheless, drywall ceilings should be an acceptable method of construction.

Next slide. Here is the proposed standard language which is in the -- that you also have. Essentially it says that there's two situations for insulating the roof/ceiling of nonresidential buildings. You either put the insulation in direct contact with the top side or under side of the roof deck; or you place it in direct contact with a continuous ceiling that forms an air barrier like your drywall ceiling.

And then that insulation placed on top of movable ceiling tiles are deemed to have no thermal effect. And then we have the exception that when the height of the space between the ceiling and the roof is greater than 12 feet, then placing insulation on top of the ceiling tiles is an acceptable method.

Next slide. In section 143, which is the -- which defines the prescriptive requirements for roof and ceiling of insulation, this just essentially highlights that there's limitations on where you can put the ceiling insulation -- there's limitations on using insulated ceilings as complying with this section.

Next slide. And that if we're going to allow drywall ceilings, you know, which the basis of accepting drywall ceilings is based on their lower infiltration rates, then we should also require that the light fixtures that go into those drywall ceilings be IC rated so that they're covered with insulation and that they be low leakage.

And that's the presentation.

MR. ALCORN: Thank you, Jon. Are there any questions or comments on the presentation? Bob Raymer.

MR. RAYMER: Bob Raymer with CBIA. I don't know if you want to go to this table, the one that shows the age and uncovered percentage. I think it's like the third or fourth -- yeah, that one.

MR. McHUGH: That's right, that's --

MR. RAYMER: Yeah, I would have expected there to be a more clear correlation between the age and the uncovered percentage. But since that doesn't seem to be the case, did you notice as you were doing this any type of correlation between the type of commercial activity that was taking place and the percentage of uncover?

MR. McHUGH: That's a good question. I haven't looked at that correlation, but that's a good question. These were primarily --

MR. RAYMER: I mean, that's awful.

MR. McHUGH: -- retail and small offices is the occupancies that you're looking at.

And what's, to me, which was counter-intuitive was the amount of range that you found in new buildings. I was hypothesizing you could see this sort of a straight line that, you know, as the building got older and older the insulation coverage would get worse.

One thing in the selection process for these buildings is that they were buildings that had either been remodeled or constructed in the last five years. So perhaps some of this remodeling activity involved replacing insulation

MR. MAHONE: It might also just be an effect of the sample size. You know, if we had a lot more buildings with a lot more different vintages and a lot more types of activity, you might start to see a clearer print.

MR. RAYMER: Yeah, but you've got a huge lump right there at like one, two and three years. I mean that's very clear there's a problem.

MR. ALCORN: Tom.

MR. TRIMBERGER: Proposed standard language as shown in the PowerPoint does not match the proposed standard language in the measure analysis.

MR. McHUGH: That's correct.

MR. TRIMBERGER: So, for the -- the analysis says, doesn't talk -- it makes the same requirement whether it is a T-bar ceiling or whether it's a gypboard ceiling.

MR. McHUGH: Right. And this is one of those things where, you know, taking a step back and looking at the issues. You know, when we first did the analysis, went, gosh, you know, drywall ceilings are just not cost effective.

And in taking a step back and going, well, it doesn't really matter if drywall ceilings aren't cost effective; they're, you know, essentially energy equivalent to the insulated roof deck buildings. And given that they're essentially energy equivalent, we're not in the business of preventing people from building expensive buildings. Our role is just to prevent them from being energy inefficient.

So, in recognizing that I changed the language between the written document and the PowerPoint presentation to take account of that.

MR. TRIMBERGER: So is the PowerPoint the one that --

MR. McHUGH: That's the one I'm proposing, yeah.

MR. TRIMBERGER: -- to be going forward with? Okay.

We have also -- you had the one case where you were getting infinite benefit/cost ratios.

MR. McHUGH: Right.

MR. TRIMBERGER: Is that assuming that the insulation cost, you know, if you put R-19 it costs the same whether you put it on the ceiling or at the roof?

MR. McHUGH: Well, it's actually two things. One is that it costs a little bit more to put the insulation up on the roof than it does just draping them over the tiles. But, in addition, there is a cost of duct tightening.

So when we're looking at lay-in insulation, we found that the benefit/cost ratio of tightening ducts above lay-in ceilings was, you know, fantastic; you know, typically 5 or something, you know, 3 to 7, or whatever the number was. That given that that's very cost effective that we use that as the comparison for comparing drywall ceilings with tight ducts versus insulated roof decks with loose ducts.

Because we also found that tightening ducts under insulated roof decks wasn't very cost effective, or marginally cost effective. So, given that, that was our base for our comparison.

When you do that you find that the cost of tightening the ducts and putting in the lay-in insulation is essentially equivalent; I think it was a penny more per square foot. So essentially equivalent. So there's essentially no cost.

So there's energy savings divided by essentially zero. So that's why we had an infinite benefit/cost ratio.

MR. TRIMBERGER: Okay. So, but the -- so you did look at the cost of putting in insulation up to 25 feet and attaching it to the joists, roof joists, it is higher than just sticking the same insulation on ceiling tiles?

MR. McHUGH: No, no, it's about 30 cents cheaper to just drop in the lay-in insulation.

MR. TRIMBERGER: Another issue that comes up in construction a lot, and you know, you kind of got to look why are people doing it this way. Well, T-bar ceiling is very quick to put up; it's easy to put up. It's flexible.

And additionally, with the insulation at the roof deck to put that in that later the trades will come on and they're going to be attaching to the joists for their hangers, for heating, air, plumbing, fire sprinklers, electricians and everything, that after the fact they've got to go in and do repair to that.

They'll insulate the ceiling before the hangers go up; all the work goes in. And in the process it gets mangled a lot and there is repair there.

That's been one of the things that I've had people come to me about and say, Tom, you know, we don't want to come in and do the roof deck now. Can we do it later. How will we do that.

So, that's just one of the kind of hidden costs of insulating at the roof ducts.

MR. ALCORN: Thanks, Tom. Ahmed, did you have any questions?

MR. AHMED: Yeah, --

MR. PENNINGTON: Before we go there, Tom, what is your overall view of this proposal?

MR. TRIMBERGER: In a lot of ways it -- overall view. I don't get that question very often, thank you.

SPEAKER: Be careful.

(Laughter.)

MR. TRIMBERGER: Yeah, there's got to be a reason you asked me that.

SPEAKER: He's been going to too many Building Standards Commission meetings.

(Laughter.)

MR. TRIMBERGER: This is something that the Commission tried to do years ago in a standards change. And the industry was so entrenched in doing it that they pushed to keep doing it.

I guess now that research is done, it seems more do-able. It seems like a no-brainer to do it. It's going to cost more to build the building, but you're going to get a better building.

It's going to take a little longer to build a building, and time is very important to people. There will be resistance to this.

And one of the enforcement issues I see is in remodels is we got these things all over the place. So you can have a shopping center at a little strip mall where you've got one section that's insulated at the roof, and the next one's in the ceiling, and one's at the roof.

There are problems, and maybe some of that can be addressed in the manual, say, you know, we're not trying to create retroactivity. We do need to look at the insulation locations in adjacent spaces.

The numbers bear out, it's kind of intuitive, that you know, T-bar ceilings leak. You go up there and you look down at them and you can see the light coming through. It's absolute. It's not really a good envelope material.

But then how do you enforce that and get that fixed? So, I think it's a good measure. It may have a little bit of language in the manual that might clarify some things.

MR. ALCORN: Thanks. Doug, did you want to respond to that?

MR. MAHONE: Yeah, I was just going to point out it seems to me that once you got the insulation up there at the roof deck that all the future changes that you want to make in the ceilings and the lighting and the ducts, wiring above the plenum or above the ceiling and all that becomes easier because you don't have the insulation in the way.

MR. TRIMBERGER: Right, but if you've got the existing building where it's at the ceiling, how are yo going to do alterations, and to what extent do the alterations come in?

Typically they'll tear out the whole ceiling; they'll put in a new T-bar, and it's two feet higher. Well, are you going to insulate that space at the roof? It doesn't make sense if the other spaces are still insulated at the ceiling.

MR. RAYMER: Yeah, I agree. For new construction this is going to give sort of the incentive to take to look at your exterior envelope and to take care of it at time of construction.

He's got a legitimate concern, though. When you've got that 20 or 30 year old building, you've --

MR. TRIMBERGER: Or a one year old building.

MR. RAYMER: Yeah, yeah. And all of a sudden if that's been out there, built under the old regulations, you don't want to have a patch of insulation here and a patch of insulation over there, and then one down here. You have to address that.

But I think this will promote taking care of the envelope at time of construction.

MR. TRIMBERGER: Yeah, I think there's also, once people realize what's going on, if we're looking at nonresidential duct tightness, that's a strongly related issue that Jon mentioned. That would be a strong incentive to insulate at the ceilings that way.

MR. ALCORN: Right, okay, --

MR. TRIMBERGER: And also probably something in the manual or standards, too, about attic ventilation, too, changes when you can't put your turbine vents up there in the ceiling; can't have your ventilated attic that's common practice now, too.

MR. PENNINGTON: That is a concern that came up in doing this work, is, you know, if you get the insulation installed at the roof you don't want that plenum space ventilated, and are people going to ventilate it because they think it's absolutely needed for some reason; or they're not paying attention; or whatever. And so they can disrupt what's being attempted here.

MR. TRIMBERGER: I think there's some

building code requirements for ventilation; I'm not sure exactly how they kick in. But trying to avoid mold and mildew issues in attics from deteriorating the structural members.

MR. ELEY: I think it comes down to the definition of an attic. And we don't want to call this an attic.

MR. TRIMBERGER: Right, we don't want to call it a plenum; we don't want to call it an attic.

MR. ELEY: Because if we call it an attic then the code says the attic has to be ventilated.

MR. TRIMBERGER: Right.

MR. WARE: Right, I was actually going to talk to that issue, but --

MR. ALCORN: Okay. Ahmed.

MR. AHMED: Just a comment. I was wondering, it was kind of difficult to understand the graphs. Is tight ducts going to be a requirement for nonres buildings; and should this analysis be done with the assumption of tight ducts is already there instead of assuming the benefit of the tight ducts are part of the benefits here?

I was trying to understand this, maybe you can explain this.

MR. McHUGH: Sure. And this is one of those things where the different proposals are very tightly interrelated because you get different answers depending on what happens with the ducts.

And that's also why I kind of re-presented some of the information about duct typing in this presentation, to point out the rationale of why we're preparing T-bar ceilings or insulated drywall ceilings with tight ducts versus insulating at the roof deck with loose ducts.

You know, the main conclusion when you look at all those cost/benefit tables is that it's not cost effective to tighten ducts, or marginally cost effective to tighten ducts underneath an insulated roof deck; but it's very cost effective to tighten ducts above an insulated ceiling.

MR. AHMED: No, I wasn't concerned about that.

MR. McHUGH: Okay.

MR. AHMED: I understand that.

MR. McHUGH: So that's the basis of the analysis to do the comparison. So, comparing --

when I compared T-bar ceilings to insulated roof decks I'm comparing a T-bar ceiling, you know, essentially an attic; that attic is ventilated. And it has tight ducts.

Now, comparing that against a building that has an insulated roof deck and ducts aren't sealed because it's not that cost effective to do that.

MR. AHMED: It's almost like as if you're counting the benefits of the tight ducts in the analysis --

MR. McHUGH: Actually -- actually --

MR. AHMED: -- and that's --

MR. McHUGH: -- I'm discounting the benefit of tight ducts, --

MR. AHMED: Okay.

MR. McHUGH: -- right? Because the thing that I'm looking at, looking at the cost effectiveness of, I have it with leaky ducts. It's going to be even more cost effective if -- well, it's going to be less cost effective because tightening ducts in those situations isn't very cost effective, right.

So the savings are less, but the costs are also less because I haven't tightened up those ducts.

MR. ALCORN: Bob.

MR. RAYMER: Just a question on the references here, on your mandatory requirements for recessed lighting in continuous ceilings.

You make a reference to ICBO. And starting in January it's my understanding that the codevelopment and publication aspects of ICBO will have been merged formally with Southern and BOCA. it'll be called International Code Council.

I'm not aware if ICBO -- I think ICBO is going to maintain a testing and certification process, their evaluation process that everybody's so familiar with. But the laboratories, I think you may want to look at changing the reference from ICBO to ICC.

MR. McHUGH: Okay.

MR. RAYMER: Because we're looking at something that will be taking place in 2005.

MR. McHUGH: Sure.

MR. ALCORN: Where are you looking, Bob?

MR. RAYMER: This is the next-to-the-last --, which is -- this is the last page.

MR. McHUGH: The last page.

MR. RAYMER: Yeah. Second bullet, last

line.

MR. ELEY: Well, this is an issue throughout the standards. Is ICC going to kind of renumber everything, and should we start making references to ICC documents everywhere we now reference ICBO?

MR. RAYMER: That may be irrelevant.

MR. WARE: Well, it's not quite as crystal clear, unfortunately. Bob is correct, ICBO has formally entered into an agreement with ICC. They have been hold-outs. But that agreement is in writing and will be formalized soon, if not already formalized.

And the evaluation service that currently ICBO administers will be formally wrapped under the national evaluation service. ICBO will continue and all the remodel code groups will continue to basically administer, you might say, instead of their program, the NES program.

But the issue is in 2005 California still may have no adopted the ICC building code, but nevertheless the testing criteria for products and materials will by then certainly be wrapped under ICC procedure.

So I think someone needs to take a look

and scratch their head over the references in the standards, because by 2005 many of those references will no longer be in existence.

MR. RAYMER: I don't want to go too far down this road, but there's also the curious circumstance that we're under. Starting in October the Building Standards Commission will begin conducting a series of meetings to look at what building and fire codes they're going to be using in the year 2005. And that is which of the national codes.

Theoretically, I mean hypothetically it's possible that California won't be using any ICC code. It's possible we could be using three starting in 2005. But we're not going to know that for probably I'd say six to eight months at least.

MR. PENNINGTON: Maybe we won't know that before we adopt these standards.

MR. ELEY: That's what I'm wondering.

MR. RAYMER: Right.

MR. ALCORN: Dave.

MR. WARE: I have a series of comments that I'd like to make. But first of all, just let me say Owens Corning has reserved support for what's being proposed here.

MR. McHUGH: All right.

(Laughter.)

MR. McHUGH: Thank you.

MR. WARE: Okay. The first item, actually it's in the report, beginning with page 27, on the environmental impact, and also, Jon, you made a reference in the early part of your presentation on the environmental impact regarding the possible exposure to respiratory hazards of inhaling fiberglass. I would ask that that be removed. There is no scientific research to support human exposure to glass fibers as being a hazard.

And in addition, this year the World Health Organization removed their classification of glass fiber as a possible carcinogen to a -- I'm not getting the words right, but anyway, removed that classification.

So, I would ask that that be, at least the wording, if nothing else, be couched somewhat differently than that. Because there is no science to support that.

I do understand the heightened concern that people have these days regarding environmental issues, but that statement simply isn't true.

Also on page 28 you talk about using Sacramento, Stockton and Vallejo to average costs. I'm just curious why, if nothing else, why you chose three cities that are so near to each other. And I would guess not necessarily have too much differences in cost.

There's no southern California cities, for instance. It's the first time I've seen anyone pick on the City of Vallejo to use as a reference, not that it should matter. But I was just kind of curious. You just chose three northern California ones as opposed to at least making an attempt to look at something other than up here in this part of the state.

MR. McHUGH: Well, that's a good question and -- go ahead. Was there anything else?

MR. WARE: Yeah. Some of my comments, I'm sure, is not going to change the analysis, but I'm just kind of curious, just more to make it robust and explain some of the underlying issues.

On page 30 there's a ranking of the insulation longevity by your interviewees, and again I don't expect the ranking at all to impact the results; but it does seem that these are, you know, really only had two interviewees out of the five that, you know, you talked to that made an attempt to talk about the longevity and guesstimate what the longevity of the insulation systems would be.

I provided the Commission, as well, my ranking of those. And I don't purport that my ranking holds any more merit than these people. That's all I'm saying.

MR. McHUGH: We didn't use this in the analysis.

MR. WARE: Yeah, I --

MR. McHUGH: It's background information.

MR. WARE: On page 31 it talks about the phone interviews. Basically you were trying to identify the number of, or get some qualitative estimate of the number of insulated dropped ceilings that you have. And I think that they're out in the marketplace.

And what we did is I made a call to a number of our Owens Corning contractors. Your statement here is about 10 percent of the buildings have lay-in insulation. We actually find, at least from our contractors, that about 40 percent of their work in these kinds of buildings is in installing insulation over horizontal dropped ceilings.

Again, that doesn't necessarily change the results that you have reported, but it implies that there's a lot more dropped ceilings that are being insulated possibly in the marketplace than your data has. Again, that's just another piece of information.

MR. MAHONE: Just a clarification, Dave. You're saying that 40 percent of the work that these contractors do involves insulation on the ceilings or that 40 percent of ceilings are having lay-in insulation?

MR. WARE: Forty percent of the ceilings in this building type are having insulated dropped ceilings.

MR. McHUGH: And building type being small commercial.

MR. WARE: Yeah, small -- I was very specific to make sure we're talking about the same building type. Oftentimes framed small offices or tilt-up warehouse office type buildings. A lot of drop-in insulated ceilings.

A series of pages from 39 to almost 42 or more you used -- the issue here is that you are beginning to analyze the effects of different insulation types and different scenarios, plenums, you know, above roof deck, below roof deck. And you're using foil-faced insulation.

It doesn't affect the results, the conclusions that you're getting at, but foil is rarely used. That is the exception to what's used in the marketplace.

And I raise that because you specify an emissivity or because foil is used, it affects the resistance emissivity qualities of the material. Probably isn't going to make a difference on the results, but foil, again, is rarely used. It's usually a foil scrim; it's a nonreflective surface; low vapor retarder; low therm rating material if it's exposed or sun-faced. For whatever it's worth.

And I guess that's primarily the major comments on the report. Oh, last -- yeah, before I get into the actual code language, the issue on, starts on page 44, and it goes all the way through the end until you get to the actual proposed code language, the issue of ventilated roofs versus non ventilated roofs, the code language says that you have to install the installation against the roof deck.

I think what we need to clarify, also with Tom, the issue of what the code says when it talks about the ventilation requirement. The ventilation requirement, and Charles alluded to it, it talks about attics, and it also uses the word rafters.

I would say, and I get questions on this issue all the time, this could be a loose cannon in respect to many building officials require a ventilated roof for everything. Okay, for commercial buildings and for residential structures, as well. I don't mean high rise commercial; you know, these kinds of building types. These kinds of commercial buildings that we're talking about here.

Usually if I, or if I explain the nomenclature in the semantics of the code it uses the term attic; this is not an attic typically. And it uses the terms rafters. Rafters are typically not found in commercial structures. That's a squishy thing.

But, I think that you have to be careful and insure, I don't know, maybe you could at least float this language around building officials a little bit more to get some feeling from whether they understand what's being proposed here, and are not going to impose the ventilation requirement that's in the building code for these kinds of commercial buildings.

MR. PENNINGTON: We would really like to clarify this issue because, you know, a bunch of our savings gets disabled if that ventilation occurs. And so we were thinking that we would clarify that it's inappropriate to be ventilating if you're insulating at the roof.

MR. MAHONE: Yeah, you see the construction all the time in retail and big box where there'll be some kind of truss system; there'll be what I'll call perlings rather than rafters --

MR. WARE: Perlings, yes.

MR. MAHONE: -- spanning between the trusses. And there will be faced insulation stapled up between those perlings. And unless there's something going on that I'm not aware of, there's no ventilation occurring above that insulation.

Nor is there typically any ventilation of the whole space below it, other than the, you know, the people ventilation.

MR. WARE: That's correct, I mean I see that all the time and I have letters that say that those kinds of perlings don't constitute a rafter as one would colloquially define. I've worked this issue to death.

Nevertheless, there are building officials that will say I don't care. I want, I'm concerned about durability; that is what this section of the code deals with; my interpretation is that you ventilate it.

So it then goes back to the designer to figure out, scratch his head and figure out, now, how in the heck am I going to do that.

So, the issue here is I think we need, if nothing else there needs to be a piece in the design manual and/or in the blueprint, at some point, that says that that section of the code doesn't apply to these kinds of structures.

MR. PENNINGTON: I think it's a good idea to try to resolve this ahead of time to the extent that that's possible with building officials.

MR. WARE: My last issue has to do with the actual code language; it's both in the main document, but if we pick on the code language that actually Jon is proposing, section 118G or 125, the last sentence says: Insulation placed on top of moveable ceiling tiles shall be deemed to not have no effect on envelope heat loss.

Actually I don't think that that -- I think that that entire sentence should be removed. It adds nothing to the requirement. And it is not necessarily a mandatory piece of required words. It's just saying that, you know, it's a design manual kind of thing.

The requirement is that here's where you install your insulation and these two things. And that's all that needs to be said.

Because, I mean -- anyway. That sentence doesn't add anything. It actually confuses what the requirement is. Oh, you mean I have to think about the dropped ceiling.

MR. McHUGH: I think, well, when I read it I thought it clarified that indeed that laying in insulation would not be given any credit. I thought it was clarifying; whether it needs to be in the manual, I don't really have a problem with. That was the thought behind it.

MR. TRIMBERGER: Excuse me. So the intent was to say that the moveable ceiling tiles do not create a continuous ceiling that forms an air barrier?

MR. RAYMER: Right. Yeah, for energy purposes, won't get credit for this. You may want to put something in there for sound, but you're not going to get energy credits.

MR. McHUGH: Yeah, exactly.

MR. MAHONE: Yeah, I think Tom's suggestion is may be a better way to write it, because it basically amplifies on point number two, rather than bringing in this effect on envelope heat loss term.

And by extension the exception says that it's acceptable to have insulation on the moving ceiling tiles if the plenum height, although the term is better defined here as more than 12 feet, and by extension therefore it's not acceptable if it's less than 12 feet.

MR. WARE: Anyway, that was my suggestion on that code piece; just to clarify that. You folks can do what you wish.

MR. ALCORN: Thank you, Dave. Marshall.

MR. HUNT: Thank you. Marshall Hunt, PG&E. This is all looking good. I would, just for simplicity, wonder if we couldn't, even though the analysis supports this, but if we couldn't just drop the 12 foot rule because i'm thinking that's just another point to have to argue about. And how many times are there really buildings that are that tall. I've seen tilt-ups that go up 20 feet, but I just hate to be in Tom's shoes or anybody building official's shoes and have to argue about six inches here or a foot there, or even two feet.

The tenants change, come and go. And what would happen if we just dropped this exception and just made things simple. And just left that 12 foot rule slide and said that we just didn't have an exception.

MR. TRIMBERGER: One thing that came to mind, too, is you've got, you know, the roof deck is not constant, but it slopes for, you know, and you've got to look at your -- you know, on one side of the building it's going to be greater than 12; and the other side's less than 12; what's the average.

You've got one that's 21 feet roof height. Put the dropped ceiling in at 9 feet; oops, can't do that. You put the dropped ceiling at 10 feet, you're scot-free. So, it does -- but then you got to tighten the ducts, so it does create another level of complexity.

MR. HUNT: I think we're trying to bend over backwards being fair and it seems to me sometimes we just have, for simplicity of enforcement, to say that this is close enough to being the right answer. Most often for simplicity of enforcement we just say this is the answer. And we don't worry about the feet.

MR. McHUGH: I guess this question is kind of directed at Tom, but what do you anticipate the response being when you've got a situation where you have an industrial building, you know they have several offices in there. They'd like to put T-bar in there. And the requirement would be no, you either got to put a drywall ceiling in, or you got to insulate your whole roof deck.

MR. PENNINGTON: Well, I think that scenario, there's another scenario there, and that is that you have to extend the walls of that space up to the roof. And then insulate the roof above that space and the walls.

MR. TRIMBERGER: Right, it's very common. You've got a large warehouse area, and they'll build a small office area, sales area. Or they'll add on to that sales area.

MR. RAYMER: Military base.

MR. TRIMBERGER: And you turned me off, Bob.

(Laughter.)

MR. TRIMBERGER: Typically they'll want to put on a dropped ceiling, and the exterior walls just go up to ten feet and then it's bare space there. That's not a really attractive construction from an energy component.

I would not expect them to insulate the whole roof of the space, but they could run those walls up. And sometimes it is 40 feet up. It's not uncommon.

MR. ELEY: That's probably a case where it would be cost effective to put in a drywall ceiling.

MR. TRIMBERGER: Yeah.

(Laughter.)

MR. PENNINGTON: Relative to insulating

the walls --

MR. ELEY: Relative to extending the walls to --

MR. PENNINGTON: Relative to installing the insulation on the T-bar, it's not cost effective based on the results of this analysis.

MR. ELEY: Well, yeah. I think the real question is the T-bar ceiling is really not a thermal barrier of any kind. So, one fundamental tenet of the code is to require that conditioned spaces be surrounded by thermal barriers, and it's not a thermal barrier.

MR. ALCORN: Doug.

MR. MAHONE: Yeah. Jon has actually spent a lot of time grappling with this issue. I mean this is the problem: You got a big warehouse and there's a little space in there and they want to just put in a T-bar ceiling and plunk some insulation on top of it.

The 12-foot number, you know, it could be 10 feet, it could be 14 feet, pick a number; but it was intended to address this case where you've got a relatively small portion of the space that's conditioned; the rest of it is unconditioned.

For awhile we thought about limiting it to a, you know, if it's 1000 square feet or smaller. Bigger than that they have to run the walls up to the ceiling and insulate it up at the roof.

There's variations that we played around with, but it seemed clear that we had to have some kind of an exception to deal with those conditions. It's fairly common. And, you know, you just get laughed at if you say insulate the entire roof deck.

So, this is the compromise that after thinking about it a lot seemed to be the most straightforward way to do the compromise. Basically says yeah, you can put the insulation on the T-bar ceilings, but you have to tighten the ducts. And you can only do it if it's one of these big spaces with a lot of plenum up there.

So that's why it came out this way. Seemed, after a lot of thought, to be the most reasonable compromise.

MR. ALCORN: Dave.

MR. WARE: In that scenario, Doug, that you just explained where indeed you may have an internal office in a warehouse, and so the most, you know, supposedly the most cost effective way to deal with that is the drop ceiling, insulated.

The requirement says that you also, if you do that, then -- or the proposed requirement, that you also have to tighten the ducts. And then my question is do you also have to run wall insulation all the way up to the ceiling, or just to the plane of the --

MR. MAHONE: Just to the plane of the T-bar ceiling.

MR. WARE: -- of the ceiling, okay. All right.

MR. MAHONE: The alternative is to run walls all the way up to the roof and insulate those walls. Those actually, under the code, are demising walls. You only need R-11 insulation in demising walls.

MR. WARE: Okay, well --

MR. MAHONE: In that case you would not have to tighten the ducts.

MR. WARE: Okay. Last comment. You're using the term air barrier here, and it's also come up in some of the residential installation protocols. Air barrier is not defined, to my understanding, in the code. And I would suggest that you define that, particularly if it's going to be referenced in the code language like this.

MR. TRIMBERGER: Oh, yeah.

MR. WARE: You'd better define what that is.

MR. ALCORN: Okay. Thanks, Dave. Tom.

MR. TRIMBERGER: I just want to echo that, that that would be an excellent definition to put in there.

Have we looked at all about, you know, not all T-bars are the same, but you can get the one-hour T-bar where it's more substantial, the panel is thicker, it's heavier. And the panels actually clip in and are mechanically held together. I don't know that they're gasketed, but that was one -- when we tried once in the past to look at making a change to the energy standards to eliminate lay-in ceiling insulation, that ballasting, that was something that people had proposed.

Did you get a chance to look at that at all?

MR. McHUGH: The infiltration information is very minimal and the only published reports I could find in the United States were

FSAC, and so it's a limited sample size. And I bet that it doesn't have any of what you're talking about.

MR. ALCORN: Are there any additional comments or questions on this topic?

Okay, seeing none and hearing none let's go ahead and take a break for lunch. If we could meet back at 1:00, that's an hour and six or seven minutes from now, that would be great.

Thanks much.

(Whereupon, at 11:55 a.m., the workshop was adjourned, to reconvene at 1:00 p.m., this same day.)

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AFTERNOON SESSION

1:07 p.m.

MR. ALCORN: I hope you all had a good lunch; I think most of us were in one location. The next report is the cool roof update, and Hashem Akbari will be presenting this report, so, Hashem.

DR. AKBARI: Thank you for the opportunity. May I have the slides, please.

As it is known that this particular work is being supported by PG&E to California Institute for Energy Efficiency. And many people, including a lot of staff at the Commission, have helped us to come where we are.

Next slide, please. Before proceeding with the details of what we're going to be discussing today I would like to apologize for a couple of errors that are on the report. There are about five entries on pages 18 and 19 and 16 of the posted report that are mislabeled. And with this slide I'm hoping that it will be corrected.

Basically the mislabeling is talking about time dependent net present value versus the non time dependent net present values.

Next slide, please. In the presentation that we had on May 30th basically two major comments were raised. One of them was how about downsizing and the impact of the downsizing of the air conditioning equipment.

Typically cool roofs reduce the sizing of the air conditioners by about a quarter of kilowatt per thousand square foot of roof area. And the Commissioner Rosenfeld was particularly interested to understand whether we are including those cost savings in the report. In this particular version of the report that we have we have responded to that comment.

Secondly, there was a comment regarding application of seasonal energy efficiency 12 for air conditioning equipment versus an EER of 10. SEER 12 typically applies to small residential units. And really doesn't apply to the analysis that we have done for commercial buildings here.

However, we run the simulations with EER rather than SEER 12 for all these scenarios; and the results are available, but they are not reported in this particular report.

Going forward -- oh, let me also mention that there was a comment, and that their comment was to provide some guideline of savings for reroofing application. As we all know, the life of the roofs are a lot shorter than the life of the buildings, so a building through its lifetime would be reroofed several times. So we also addressed and responded to that comment.

This slide shows the net present value of energy savings alone ordered by the 16 climate zones in California. And basically, as you will see here, both the present value time dependent and the non time dependent values for all climate zones except climate zone 1, are above $200 per thousand square foot of roof area.

For climate zone 1, which is a very small climate, coastal zone in the northern part of California, that number is around $100 per thousand square foot of roof area.

Next, please. Once we include the impact of the savings in downsizing of the air conditioning equipment we would find out that even for climate zone 1, we are approaching a saving of about $200 per thousand square foot of roof area.

And typically for a reroofing application if one applies the same technology, only changes the color, there is no incremental cost for having a light colored roof versus a dark colored roof. So it appears that this particular measures are cost effective throughout all the regions in California. And that's the reason that we would like to recommend the standards to use reflective roof as a basecase for, or prescriptive case for the flat roof buildings.

Next one, please. Once we estimate the savings in California it is projected that about 72 million square feet of flat roof, commercial flat roof, or nonresidential flat roofs will be built every year, the net present value of all the electricity saving -- the net value of all the electricity saving is about $23 million per year. And once you include the impact of the downsizing of the equipment, that would be about $27 million.

We would be saving about 15 gigawatt hours of electricity per year. There will be a deficit of about 200 kilotherms per year by having additional heating requirement.

Next, please. It is hard to find out the exact amount of the roof areas that are changed every year. According to some data that we have we find out that in California the amount of the reroofing of the existing roof is about three times more than the new roofs.

So we just basically applied that same ratio in order to get an estimate for the reroofing market. And we are finding out in the reroofing market the present value of all the savings is about $79 million a year, and peak power demand saving is in the order of 26 megawatt. And we would be also saving about 43 gigawatt hour of electricity per year.

And with that slide, I would like to conclude my comments, and I would be happy to answer any questions.

MR. ALCORN: Thank you, Hashem. Do we have any questions on this presentation? One, Randall.

MR. HIGA: Randall Higa, Southern California Gas Company. I was just curious how the heat loss is calculated. My understanding is DOE2 doesn't calculate the, or can't take into account the -- well, maybe the question is -- I'll just ask it. How is it calculated? What is it based on?

DR. AKBARI: We used DOE2, and DOE2 does have the -- DOE2 version 2.1E, it does have the capability of including the roof absorptance or reflectivity into the calculations. And we run the basecase with the standard reflectivity or absorptivity. And we ran the modified case. And it calculates both the cooling energy savings and heating energy penalties.

MR. HIGA: Okay, so the heat loss isn't a function of emissivity, then? Or is it?

DR. AKBARI: In this calculations the emissivity has not been changed. But even once we include the impact of the emissivity, DOE2 can also do the calculations.

Perhaps the ones that are available in the market are not yet addressing the issue of the emissivity, but the research version that we have does have that capability.

MR. HIGA: Okay. I had a couple questions regarding that. One is if you want to, say, exceed Title 24 and you had a higher emissivity, whether that could be taken into account. And I guess at least the way the model is now it can't take that into account.

And the other question is if it's only looking at reflectivity/absorptivity then I guess you're considering the stored heat in the roofing system to offset or I should say -- well, let me flip it around the other way.

With a cool roof you have less absorptivity, less heat stored in the roof, and therefore your heating load is higher. Is that a correct statement? I'm just trying to understand how the heating load increases with a higher reflectivity roof.

DR. AKBARI: Let me make a couple of comments. Number one, in this analysis the emissivity has not been changed. The emissivity of both reflective roof and nonreflective roof are high. So there is no variation in emissivity.

Number two, there are some winter days that the sun, it's sunny, and having a higher reflectivity would not necessarily help particularly in the early morning hours.

So when DOE2 does the hourly calculation it estimates the balance of the energy either in the form of the heating or cooling that it is required on an hour-by-hour basis. So there are some hours of the year that having lower reflectivity would require more heating.

And when you collect all of those numbers for the prototype buildings that we have calculated, you come up to about 200 kBtu per thousand square foot on an annual basis.

MR. HIGA: Okay, I think I understand. Thank you.

DR. AKBARI: My pleasure.

MR. ALCORN: Tom Trimberger.

MR. TRIMBERGER: Hashem, I know this is just an update on a previous description, the cool roofs program. My understanding is that this was an addition to the prescriptive requirements, is that how this is going to be put in, not as a mandatory measure but as a prescriptive requirement, is that correct?

DR. AKBARI: My understanding is that it is a prescriptive requirement. Previously, the previous standard that we had, it was not part of the prescriptive, only the overall envelope approach. You could get credit, but when it came to the performance based, you could do everything with it.

Now we are moving that so that it is basically as a part of the prescriptive; then you can also exchange in the form of the credit in the overall envelope approach. And also overall performance of the building.

MR. TRIMBERGER: Okay. For reroofs that

application does not go through a compliance
procedure before a permit is issued or anything.
How are we attempting to influence the market for
cool roofs for reroofs?

DR. AKBARI: To the extent that I
understand -- I will let the staff respond to
that, but --

MR. TRIMBERGER: Right now if it's an
alteration to the building it meets the definition
of alteration, -- get into the standards. But if
it's just a reroof, that typically does not
require the building official to get calculations
to see, gee, how does your new roof comply with
the energy standards.

DR. AKBARI: Would you like to help me
on that one, please?

MR. PENNINGTON: Basically this would
be, it would be considered an alteration. And the
requirement would work the same way. It would be
a prescriptive requirement. And you could do a
performance approach on it if you wanted to.
Maybe that's unlikely to happen.

MR. TRIMBERGER: Are you saying a reroof
is an alteration?

MR. PENNINGTON: We've never had any --

anytime you alter something that's addressed by the standards, then that piece of the standard is invoked relative to that change.

MR. TRIMBERGER: No. We have a definition of alteration in the standards. It says it's a change to, I believe, the conditioned floor area.

MR. PENNINGTON: That's an addition.

MR. TRIMBERGER: That's an addition. So a reroof would be considered an alteration.

MR. PENNINGTON: And so on flat roofs if you're reroofing, this requirement would be invoked.

MR. TRIMBERGER: Okay. I'm not real familiar with the products, the cool roof products out there, but I know business owners, building owners are very very sensitive to their roofs. Is this basically the same type of roofing, but different color? Or, you know, are they still going to be able to get the warranty and everything else that they want?

DR. AKBARI: Based on the market analysis that we have done, particularly for flat roofs, there are choices of color almost at no incremental cost.

MR. PENNINGTON: So is it true, just a kind of follow-on to what Tom is talking about, is it true that it's feasible to do any reroof as a cool roof and there's really no roof type that it's infeasible to go to a cool roof?

DR. AKBARI: For a good majority of the buildings the answer is yes. But you can always find in the building industry some exceptions.

I would like to particularly provide a current example in this current building, this Commission building is being reroofed. And on a conference call that we had last week with the contractor, one question was what's the price difference between white membrane and a black membrane that they're going to install. And the answer was nothing, zero.

MR. TRIMBERGER: There's no difference then in warranty performance issues?

DR. AKBARI: Absolutely none. What actually there is a general belief that light colored roofs last longer. So there is a kind of feeling of easiness in the manufacturers that they are better off with the reflective roofs.

MR. TRIMBERGER: Thank you.

MR. ALCORN: Thank you, Tom. Dave Ware.

MR. WARE: I have a question somewhat related to Randall's. In the analysis of savings what was assumed for -- I assumed that there was insulation underneath the membrane someplace.

DR. AKBARI: Correct.

MR. WARE: It was either BUR or it was underneath the roof deck or something.

DR. AKBARI: Correct.

MR. WARE: I didn't find a table in here, but --

DR. AKBARI: There is a table in here that gives that number and the assumptions are the prescriptive requirement for the Title 24. And in some climate regions it is 19, R-19. In some climate region it's R-11. But it is based on the recommendation of Title 24.

MR. WARE: But did you, in the analysis, do -- where I'm leading to here is aged R value. What we have --

DR. AKBARI: No.

MR. WARE: And I think -- I know you didn't take account for that, and I think you and I had some discussion with the Commission sometime ago around aged R value. And we are seeing aged R value particularly in built-up roofing systems or commercial roof decks as being a big deal.

And so what I'm hearing --

MR. ELEY: You mean aged absorptance, or aged R value?

MR. WARE: Aged R values of insulation materials being exposed -- polyIso versus extruded, et cetera.

I know ASTM has been working on this, but I was curious whether there was any attempt to deal with that issue in the context of the energy benefits of cool roof technology.

DR. AKBARI: In this report we haven't done that. And the comments or the responses that I make are based on my general understanding. Having, as the insulation value degrades over time, the impact of the light colored roofs becomes even more pronounced.

So, the savings increases significantly if you are thinking that you are R-19 on your roof, but the reality of an R-13, your saving because of the cool roof is probably about 50 percent more than what it is being reflected in here.

But in here we basically follow the letter of the law and assume that R-19 and R-11.

And we try to avoid that head-to-head discussion and --

MR. WARE: Okay.

DR. AKBARI: It is a tangential issue which is only strengthening the application of the reflective roofs.

MR. WARE: I think I agree generally with what you're saying. At some point the Commission needs to deal with aged R value stuff. I'm not so sure that the code arena, if you want to call it that, or the testing arena, standards arena, is quite there yet. But I appreciate your answer.

MR. ALCORN: Thank you, Dave. Are there any more questions or comments? Jon.

MR. McHUGH: Does this proposal essentially outline sort of the hot -- built-up roofing, is that essentially, I mean what are the repercussions of the proposal?

DR. AKBARI: Clearly moving the arena from giving credit to cool roofs is requiring a stringent criteria for hot roofs, so there are ways to compensate for that. Is that correct, Bill?

MR. PENNINGTON: This is the

prescriptive requirement, the basis of the performance standards. So it's not outlawing any product --

MR. McHUGH: But you have to yet do something to --

DR. AKBARI: Absolutely, yes.

MR. McHUGH: Okay, thanks.

MR. ALCORN: Okay, Tom Trimberger.

MR. TRIMBERGER: I'm still a little concerned as far as an alteration to reroofing could be repair. You know, is there a percentage of the roof, or a size that, you know, -- in many cases it's an emergency repair, too. You know, a big storm comes in and wipes out half the roof and they're up there the next day.

I'm a little concerned that we may have a problem with repair versus alteration of looking as in putting a new compliance path here for a reroof.

MR. PENNINGTON: Good point. Any responses to that?

DR. AKBARI: I share that.

MR. ALCORN: Okay. Elaine Hebert.

MS. HEBERT: Hi, this is Elaine Hebert from the Energy Commission. Following the discussion we had this morning on lay-in, I had a comment that I made offline to some folks after the morning session. And I just wanted to get it online.

And that is I'm hoping that somebody, if not the Energy Commission, that somebody will develop a guideline or something that will help people considering building a new building, or reroofing or whatever, to analyze whether a cool roof, a radiant barrier roof or certain levels of insulation will be the best choice for them.

And right now I don't know that we're integrating those approaches. I'm hoping that somewhere along the line we'll be able to offer some help to new buildings and alterations that will help determine what is the best, given all the, you know, first cost, life cycle cost, comfort of the building and energy bills and all that stuff, that we'll be able to give some guidelines on how to do that well.

DR. AKBARI: I fully agree with Elaine's comments. The interesting thing here is to recall a lot of people ask this question, is white color reflective roof as effective on an insulated building versus uninsulated building.

And I immediately reverse the question and say that is the insulation is very effective on a light color roof building or dark colored roof building.

So there is the question of the trade. And based on the data that we have, the incremental costs for cooling roof versus a hot roof is almost zero, when the roof is being done; either it's new or the time of the reroof.

But, every inch of insulation that is being laid, one has to pay for it. So basically there is an optimization problem in there. In addition to that, when you add the equipment sizing, and when you add the question of the radiant barrier. So such a tool is really necessary to be able to perform an optimized calculation for individual buildings.

MR. ALCORN: Any additional comments or concerns?

MR. AHMED: This is something I'd like to ask you. Why wasn't that optimization done in your analysis? You could have done that, right?

DR. AKBARI: No. Already Title 24 does have requirements for the level of insulation for a building. And the criteria that we were having is that working with those requirements, or those constraints, or what the present value of insulation is, to do the cost/benefit analysis on this.

In a different report that I have done, and it is published and it's available in the literature, I have done an optimization, limited optimization analysis only comparing the impact of the reflective roof and insulation. Not even downsizing of the equipment.

And I'm finding out in some places -- let me give you one specific example. If you want to put an R-30 in a place like Miami Beach for a dark roof, you can get away with putting R-3 on that building and having a reflective roof on that building.

Clearly when you move north to Minneapolis the conditions would not look that favorable.

So that kind of optimization are needed. But in this analysis, the way that Title 24 has been basically added together or pieced together, it wouldn't allow for that kind of flexibility.

MR. AHMED: So would you say that in the standards manual, in the standards, some sort of, as Elaine has suggested, some sort of guidelines as far as by climate zone combination of equipment sizing, radiant barrier, insulation and cool roof, some sort of guidelines be set so that the designer gets a good signal that in this climate zone this particular combination works best?

DR. AKBARI: Well, the answer is yes. And then from the optimization I also should like to mention the incremental costs for cool roofs are zero.

MR. AHMED: Right.

DR. AKBARI: Optimization always converges toward the reflective roof for all climate regions. So that is basically going to be the prescriptive and the basecase. So now the tool is really required to integrate all the other valuations. Correct.

MR. PENNINGTON: It's not really the purpose of the compliance manual to try to figure out what's the optimum for any particular building. Rather it's the purpose of the compliance manual to explain how to comply with the standards. And what to do if you're going to do X or you're going to do Y, and what the requirements are.

You know, in general we don't get into trying to recommend what's the optimum set of features.

MR. AHMED: I agree with you, but the standards, themselves, almost speak for themselves. If you say EER of 12, it automatically implies that EER of 12 will be more cost effective than say EER of 11.

MR. PENNINGTON: Well, but see what you're asking is is an EER of 12 more cost effective than an AFUE of 9.2. We don't get into that.

MR. MAHONE: Actually the utilities have, through their new construction programs, have the energy design resources which provides a lot of design guidelines and software, EQuest is provided to that. That would actually be probably the better way to discuss these kinds of cross-venture optimization questions.

MR. AHMED: Yeah, the only concern, the comment I had was because it's all pertaining to one aspect of the building, which is the roof. That is the only reason I thought that some guidelines might help.

Otherwise, as far as the other measures

like whether it is appliances or walls or, you know, other factors in a building, that's up to the designer to recommend to the customer what is the most optimal for that particular building.

But since this issue is so complicated, that cool roof and a radiant barrier and the sizing, they all affect -- they are all interrelated to some extent.

So I thought maybe some guideline might help. Or maybe it should be CABEC or somebody who should disseminate this information.

MR. PENNINGTON: To a large extent my opinion is that providing tools that are effective in evaluating various measures for a given building is a good thing to do. Probably the best thing you could do.

MR. ALCORN: Are there any additional comments on this paper?

Okay, Hashem, thank you very much --

DR. AKBARI: Thank you very much.

MR. ALCORN: -- for this presentation. We'll move on to our next and last topic, gas cooling compliance options. And Steve Brennan from Davis Energy Group will be presenting this topic. Steve.

MR. BRENNAN: My name is Steve Brennan and I'm from Davis Energy Group. I'm presenting the report titled gas cooling compliance options for residential and nonresidential buildings on behalf of Southern California Gas Company.

Next slide. Overview of our proposal. We want to introduce an improved compliance option related to gas cooling equipment. The residential technologies that we want to cover are single effect absorption chiller -- air conditioner. And the commercial technologies are double effect absorption chiller, gas engine chiller and gas engine heat pump.

Next slide. The gas cooling compliance option background. Southern California Gas originally proposed improvements to the gas cooling standards in the AB-970 Title 24 proceedings. But the California Energy Commission was not able to accommodate gas cooling due to the short timeframe of the emergency regulations.

There was an agreement to address inclusion of appropriate gas cooling compliance options within the standards 2005 revision. And we've been working very closely with the California Energy Commission on this proposal.

Statewide codes and standards team, the IOUs, ranked natural gas cooling as a high priority for implementations in standards updates. The need for changes to the gas cooling standards became more relevant with the introduction of TDV methodology.

Next slide, please. Currently gas cooling is treated in the ACMs such that residential, MICROPAS includes an analysis for gas engine heat pumps. And single effect absorption chillers are only included in the standards table; they're not described in the residential ACM manual.

On the nonresidential side absorption chillers are both in the standards table and the ACM manual, but gas engine equipment is not described in either the standards or the ACM manual.

Next slide, please. The benefits of gas cooling. Gas cooling provides end users with more options to manage and control their energy use profile. There's significant electrical peak demand reduction. There's a potential for customer utility bill savings especially with time of use rates.

Opportunities for improved plant efficiencies and heat recovery. And reduce size of emergency power generation systems. Cost savings for smaller units.

Next. Scope of the change would be to add a new residential compliance option for absorption cooling. And then for the nonresidential side, we would make these changes to the compliance options.

We would add gas engine driven heat pump and gas engine driven chillers to the ACM manual and the standards efficiency tables. Modify the standards language to allow heat recovery already provided for in the ACMs. But that heat, we would only allow heat from space conditioning to be recovered, and it would have to be used for space conditioning or domestic hot water.

This proposed new defaults for absorption chiller temperature HIR curves. We also would apply hourly TDV models, residential and nonresidential technologies.

Next slide, please. The methodology we used, we analyzed gas cooling versus baseline electric systems. We compared the flat source multiplier energy use to TDV energy use for five climate zones.

We collected data from commercial equipment manufacturer to compare the current equipment on the market to the current DOE2 eligibility criteria and default curves.

And we collected data from residential equipment manufacturers to develop the ACM model.

For the residential analysis we used the California Energy Commission standard 1761 square foot house. The baseline equipment was electric, 12 SEER air conditioner. We used MICROPAS version 6.1, the research version, to generate a loads file, because the TDV version was not yet available.

The standard loads file was imported into the HMG TDV spreadsheet. And this spreadsheet includes proposed 2005 changes for electric air conditioner modeling, including fan energy accounting, et cetera.

We applied the gas absorption model to the loads data to generate gas and electricity consumption values for the gas equipment. And this model also included the 2005 assumptions.

The output of this model was used to modify the loads file to create a proposed case.

And the proposed loads file was then imported into the TDV spreadsheets which calculated source energy versus TDV compliance.

For the nonresidential analysis we used the 7200 square foot office building developed by Gabel Dodd/EnergySoft for nonres ACM tests. Used EnergyPro version 3.1 with DOE2.1E simulation engine to generate the standard and proposed energy use files.

Gas cooling equipment inputs for EnergyPro were restricted to equipment size, fan power, cooling HIR, heating HIR for the heat pump, EIR and performance curves for the double effect absorption chiller.

The output files were then imported into the TDV spreadsheet for the same comparison as the residential.

On the next slide you can see a table of comparing the electric baseline characteristics on the left to the equivalent gas cooling. This was the comparison made. So on the right, for the absorption equipment, we already have values in the table and the standards that are minimum eligibility criteria.

And that's what's listed as current.

It's the same as proposed because we don't propose any changes to that. There is nothing for the gas engine driven equipment, so we proposed a series of efficiencies there.

Next slide. Really quickly, these are the results of the single effect absorption chiller for the residential. The top table on the left-hand column shows the different climate zones that were run. And the right-hand column shows the compliance.

This top table is for flat source multiplier. The compliance margins being negative show that the equipment did not comply using the flat source multiplier.

The bottom table shows the same five climate zones when run with the time dependent valuation multiplier; and it shows that all of the equipment, or all the climate zones had compliance.

Next slide. Engine driven chiller, nonresidential. And again the compliance margins for the flat source multiplier were all negative. But with the time dependent valuations first multiplier, they were all positive actually. Kind of a wide margin of compliance.

On the next double effect absorption chiller, again noncompliance by a wide margin with the flat source multiplier. And for the five climate zones there was compliance with the TDV multiplier.

The last piece of equipment is the engine driven heat pump. And again noncompliance with flat source multiplier; wide margin of compliance with the time dependent valuation.

So this brings us to our recommendations. In the standards we went through and we found where it would be appropriate to make changes. We found that we would need to add a new definition to section 101 to include gas cooling equipment os that it's defined.

In section 1.22, tables 1-C2 and 1-C3 where the minimum efficiency, the eligibility criteria are listed, we would need to make additions for the gas engine equipment. Section 141 energy budgets, we'd need to make a very small change there to allow heat recovery from space conditioning equipment for space conditioning equipment, or DHW.

In the residential ACM we'd need to add a reference to gas equipment in equipment efficiency/method under certificate of compliance.

Add a definition for absorption chiller. Add an exception to equipment type in section 2.2, the computer method summary, so that if gas absorption equipment was specified it would be listed under special features.

And add gas absorption model to section 3.8.2 cooling equipment.

Nonresidential ACM, the only major change that needed to be made was to add section 3.5.2.3; this was a new section we developed for gas engine driven chillers and heat pumps. It works for both and it includes the heat recovery.

We would need to change the default DOE2.1 coefficient; this is a recommendation we're making. And complete an environmental impact study that we're currently working on. This will be integrated into the code change proposal and completed in early September.

And that's all.

MR. ALCORN: Okay, thank you, Steve. We'll open it up to questions and comments.

Doug.

MR. MAHONE: It wasn't clear from your presentation, one of the classic gotcha's with various gas cooling technologies is the parasitic losses for pumping and for heat rejection and so forth, which are electric loads. Has that all been accounted for in this analysis?

MR. BRENNAN: Yeah, in DOE2, working with Gabel Dodd we figured out. We wanted apples-to-apples comparison, so, yeah, we went through that.

MR. PENNINGTON: The environmental study that was mentioned at the end is going to be an important part of the Commission's decision about whether to approve the compliance option or to, you know, mitigate environmental impacts as part of the compliance option. So that's definitely a very important part of the project.

And The Gas Company has initiated a quite thorough evaluation of that, so that information will be made public when it's available.

MR. BRENNAN: And I might add that in the process of doing that we'll also be able to get quantifiable energy savings to show the benefit of reduced electricity use in addition to whatever environmental benefits.

MR. SPRINGER: Dave Springer, Davis

Energy Group. Bill, will there be some -- criteria adopted for the environmental standards or --

MR. PENNINGTON: Yeah.

MR. SPRINGER: And do we have those criteria established now, or is it something that you're going to wait to do until you see the numbers?

MR. PENNINGTON: The CEQA requirement is that if there are significant impacts then those impacts need to be mitigated, or the Commission needs to state why they're not being mitigated.

MR. FERNSTROM: Gary Fernstrom, PG&E. Just a comment on the environmental impacts. I think it's important that we look at these environmental impacts in the context of the electric crisis.

And it seems to me that some latitude was given peaking plants for operating during the summer in order to mitigate the likelihood of electric outages. And when we consider natural gas cooling as an alternative to electric, it, in effect, reduces the electric peak load. And I think ought to be given the same latitude with respect to its environmental impacts.

MR. PENNINGTON: It's not at all clear that there will be a significant impact found, at least not in all air districts. So that's one thing I would say.

The second thing I would say it's not at all clear that it would be unreasonable to mitigate impacts if they were found. And, you know, if you sort of -- if you have a problem with both of those things, then you get to the policy issue that you're talking about.

MR. FERNSTROM: Well, it's been our experience that in dealing with engine driven cooling, no matter how hard you try you can't get rid of some hydrocarbon emissions. And that's the particular issue that I'm concerned about with respect to avoiding electric outages.

MR. PENNINGTON: To avoid a significant impact doesn't mean you have to have zero emissions, because they're not the same thing.

MR. FERNSTROM: Thank you.

MR. SPRINGER: One thing I would like to mention with respect to our analysis of gas engine technologies is that a lot of the systems on the market are variable speed; and that it's easy to run, to unload a gas engine chiller, for example, by lowering the speed of the engine.

And our analysis assumed basically on and off. So it's kind of a worst case scenario.

MR. ALCORN: Ahmed.

MR. AHMED: I was just trying to understand, is there going to be any more workshops?

MR. ALCORN: Yeah.

MR. AHMED: There will be? Okay. I just wanted to understand because if the emissions study results should be presented again, or it should be just circulated. That's what I was trying to understand.

MR. PENNINGTON: We will want to present it before we're done, for sure.

MR. ALCORN: Marshall.

MR. HUNT: Marshall Hunt, PG&E. I noticed in the report there was a mention about the low NOx burners; and I'm thinking about burner technology, not engine technologies.

And I guess this would be a question to the DEG folks. I'm used to seeing most places in California requiring low NOx burners. And so I was a little surprised to see that there was sort of an optional statement made, if I'm correct in reading the report, that there might be places where we're not required to have low NOx burners? Did I misread that?

It seems like that's a mitigation that's already occurring in most of the open flame burner technologies.

MR. SPRINGER: I think that all of the gas cooling technologies have varying degrees of mitigating features applied to them. And we're not suggesting that those be eliminated by any stretch. And, you know, in fact I think, you know, we'll be proposing best available -- that they meet at least best available technology standards.

MR. HUNT: Good, because I'm thinking that a lot of times just as some simple technologies apply to those burners, reduce at least the NOx component to what, nanograms we're looking at. So, thank you.

MR. MAHONE: I realize I'm actually not clear. Is this just for performance calculations, or with the fact that there are minimum efficiency requirements mean that if somebody took the prescriptive approach they could simply put in a gas chiller or gas air conditioner that met the minimum efficiency requirements?

MR. SPRINGER: Well, we're intending this as a compliance option, so it wouldn't be applied as a prescriptive method for meeting standards.

MR. MAHONE: Okay, so it would only be a tradeoff option?

MR. SPRINGER: Right.

MR. PENNINGTON: Well, actually, David, I don't think that's the way your proposal reads. With the mandatory requirements, you know, unless there was a statement in the standards that says you can't install these prescriptively, then the standards would allow them to be installed prescriptively. And the only requirement that would be set would be the mandatory requirements.

MR. SPRINGER: I stand corrected.

MR. AHMED: That's what -- we had a discussion about this, this very topic, between David and I, we were talking about it. Whether one should be allowed to sort of, I think we have, in one of those packets, tables where you can substitute pieces of equipment; whether or not cooling could be -- gas cooling could be substituted. And we were not sure whether we were going to ask for that or whether the Commission Staff would like to --

MR. PENNINGTON: So you're talking about the residential packages?

MR. AHMED: For residential. In the nonres mostly compliance is through performance anyway. So, --

MR. PENNINGTON: Not true.

MR. AHMED: Well, I think --

MR. PENNINGTON: It's about 50 percent is what we understand.

MR. AHMED: So we were open to that idea, whether it should be prescriptive or performance. But the way it was written up, during our discussions, The Gas Company and DEG, that we'll propose it as a performance, but we would welcome prescriptive requirements, as well.

MR. MAHONE: Yeah, it seems like that's a fairly fundamental question that needs to be answered.

MR. ELEY: Well, I have a question along those lines. If it's not in the prescriptive standards, and if it's purely a compliance option, is an environmental impact statement necessary in that case?

MR. PENNINGTON: Yes.
MR. ELEY: It still is necessary?
MR. PENNINGTON: Right. The credits that were created for gas cooling equipment already in the standards, we had a fairly significant environmental analysis, and it was a significant issue.
So, yeah. You can think of it as the Commission is making a decision that will change the emissions impacts in California by approving or not approving this compliance option.
MR. ELEY: But I mean you could argue that any compliance option has a potential for doing that.
MR. PENNINGTON: Usually --
MR. ELEY: Lighting control credits --
MR. PENNINGTON: Usually they don't have possible negative consequences. Usually they're only positive consequences.
Lighting control credits generally are reducing electric energy --
MR. ELEY: But if you do, if you make decisions in the design process that result in increased heating load and reduced cooling load, wouldn't that increase emissions if you're

assuming gas heat?

MR. PENNINGTON: I don't know, maybe we should get more severe about all of our --

(Laughter.)

MR. ELEY: Well, you know, --

(Parties speaking simultaneously.)

MR. ELEY: I don't know, it seems like a slippery slope.

MR. PENNINGTON: It's a secondary effect whereas, you know, if you're doing something that will directly affect gas energy use, then it's a direct effect instead of a secondary effect.

MR. ELEY: Okay. I'll be quiet.

(Laughter.)

MR. ALCORN: John.

MR. ELEY: Said too much already.

(Laughter.)

MR. McHUGH: Related to emissions, there actually were two formats of the TDVs. One was TDVs with externalities and the other one was without externalities.

And the one with externalities monetizes, you know, the emissions impact on the state of various code requirements.

So if you want to go down that path,

there actually is a method. We've actually already invested the time required to make that valuation.

MR. PENNINGTON: Basically this environmental analysis here is an assessment of is there a significant environmental impact in each of the air districts in California resulting from approval of this change.

So it's not trying to value that or how to trade that off or anything; it's an assessment of if there's -- is there a significant impact.

MR. PIERCE: Tony Pierce with Southern California Edison. Jon, I'd just follow up on that. The TDV spreadsheet that was used for the DEG analysis was without externalities, I presume, right?

MR. McHUGH: The TDV spreadsheet is set up so that you can use either set of TDV values. And so there was a full set of 16 TDV values without externalities, and a set of 16 with externalities.

SPEAKER: It sounds like you guys used the one without externalities.

MR. AHMED: I think, if I'm not mistaken, the TDV energy values, the formula that

Charles proposed for converting TDV values to energy, I think that's based on the non external values. So I think non externality values, translating the present value to some sort of energy value. So I think that's what we stated.

MR. ALCORN: Steve Gates.

MR. GATES: With the analysis of the engine driven technologies for both residential and commercial, is there any accounting for differences in maintenance costs, one versus the other? Or is this strictly a comparison looking at source energy one way versus the other versus TDV budget energy without taking into account real costs?

MR. SPRINGER: No, we didn't look at life cycle costs or -- cost in the analysis.

MR. GATES: Okay. Is there any significant issues with noise? Like say in a residential area where you're going with engine driven heat pumps versus electrically driven equipment and impacts on, you know, adjacent properties, that type of thing?

MR. SPRINGER: Well, first of all, for residential gas engine heat pumps are no longer available. And we're not proposing that they be taken out, necessarily, but we're waiting for someone to come in to promote them, if they're available. And so I think they'll basically fade away in the 2005 standards unless, you know, a manufacturer steps forward quickly between now and then.

MR. GATES: I see.

MR. SPRINGER: And gas absorption is generally quieter than --

MR. GATES: Yeah, the gas absorption we think could be pretty quiet.

MR. SPRINGER: Yeah. And, you know, as with emissions, there are, you know, there are local standards on noise emissions, and there are mitigating measures can be applied. So we're just going forward assuming that the local standards will be applied, and that they can --

MR. GATES: Okay.

MR. SPRINGER: But we haven't looked at the cost effectiveness.

MR. GATES: All right. For the purposes of the record I'm Steve Gates with Hirsch and Associates.

MR. PENNINGTON: Steve, just also responding to the question, looking at that noise impacts would be part of the environmental analysis that we would do. So, we're looking at it.

MR. FERNSTROM: Just a comment on the noise issue with respect to the old triathlon equipment, the noise of the engine was really swamped by the noise of the condenser fan. So, that equipment, you know, had no appreciable noise impact residentially.

MR. ALCORN: Thank you, Gary. Any remaining comments, questions?

Okay. Well, it looks like we've made it through the end of the topics. Amazingly we're almost an hour ahead of schedule.

MR. TRIMBERGER: Save those for the next workshop.

(Laughter.)

MR. ALCORN: I wish we could. I'd like to thank you all for this very beneficial and useful workshop.

SPEAKER: Bryan, could you tell us --

MR. ALCORN: Yeah, that was -- actually we're working right now trying to pin down the schedule for the next phase of work.

At this point we haven't worked all the

way through that yet. We think that there may be a workshop in late October. But, again, that isn't pinned down.

What I encourage you to do is watch the project website for announcements I'll be making there. And also I will be sending out broadcast emails to give you a heads-up for planning your calendars.

Any questions about that? Tony.

MR. PIERCE: So not September, though?

MR. ALCORN: Well, probably not, Tony. We're thinking of probably late October for the next workshop.

MS. HEBERT: What is likely to happen at the next workshop?

MR. ALCORN: Well, actually the next phase of work is going to be drafting the standards language, so we're starting that process now. And it's going to be sort of a continuation. We already have the draft language that's in the reports, and we'll be working with each of the authors to -- and Charles and his team to hone that language into --

MR. ELEY: We're actually going to try and bring both the draft standards and draft ACMs, or at least changes to the ACMs, forward at the next workshop.

So what you'll see, Elaine, at the next workshop is our attempt to kind of take these 50 or so codes change proposals and put them into the standards and the ACMs.

MR. ALCORN: Okay.

MR. ELEY: Responding to all the comments.

MR. ALCORN: All right. Well, thank you all very much. We'll keep you posted on the next workshop.

(Whereupon, at 2:10 p.m., the workshop was adjourned.)

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CERTIFICATE OF REPORTER

I, PETER PETTY, an Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission Workshop; that it was thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop, nor in any way interested in outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 5th day of September, 2002.